SESSION I
TIME: Tuesday 13 April, 8:30-10:00
ROOM: Maryland - C
TRACK: Ecosystem Restoration
TOPIC: Innovative Analytical Procedures and Tools
MODERATOR: Les Tong, South Pacific Division

PRESENTATIONS:

Title: The Ecosystem Functions Model: A Tool for Restoration Planning
Presenters: John Hickey, P.E., IWR-HEC, and Chris Dunn, P.E., IWR-HEC

Abstract: The Ecosystem Functions Model (HEC-EFM) is a planning tool that analyzes ecosystem response to changes in flow regime. The Hydrologic Engineering Center (HEC) is developing the EFM and envisions environmental planners, biologists, and engineers using the model to help determine whether proposed alternatives (e.g., reservoir operations or levee alignments) would maintain, enhance, or diminish ecosystem health. Project teams can use the EFM to visualize existing ecologic conditions, highlight promising restoration sites, and assess and rank alternatives according to the relative enhancement (or decline) of ecosystem aspects.

Presentation: 1) demonstrates use of the EFM process - statistical analyses, hydraulic modeling, and GIS, 2) introduces new model features, including low flow frequency analyses, selection of a water year range, analysis of individual water years, and enhanced output, 3) discusses a case study for the Savannah River Comprehensive Study, and 4) concludes with ideas for future development.

This software is a general tool, applicable to a wide range of ecotypes and Corps projects. Beta version and test version 1.0 are available for use. For more information or to obtain a copy of the EFM contact John Hickey, HEC.

Title: Comparative Analysis of Management Alternatives for Dredged Material in NY/NJ Harbor
Presenters: Gregory A. Kiker, Ph.D., ERDC, and Todd S. Bridges, Ph.D., ERDC

Abstract: As environmental awareness and concern has increased among the public, so too has the complexity of the questions posed to decision-makers. Resource managers and regulators are increasingly faced with reaching credible conclusions about the extent and magnitude of risks, and how best to manage those risks, based on limited and uncertain data. In response to these challenges, tremendous advances have been made in the science of risk assessment. However, our ability, at a practical level, to use this information to make decisions involving multiple stakeholders has not kept pace. As a consequence, a gap exists within the decision making process between the conclusion of a risk assessment and the point at which specific decisions are reached about how risks will be managed at a site or project. This gap is characterized by the absence of robust decision making tools and models for organizing and combining the dense and diverse information produced by a risk assessment with stakeholder values within a logical analytical framework. We will not realize the full benefits of the advances made in environmental risk assessment until we fill this gap in the process. As an example of these new paradigms and decision tools, a case study from New York/New Jersey harbor will be presented that combines dredged material management, comparative risk assessment and multicriteria decision analysis. Results from this case study highlight the advantages of integrating the risk and decision methodologies to provide structured and defendable decisions to complex environmental challenges.

Title: Conceptual Models and Their Use in Ecosystem Projects
Presenters: L. Jean O'Neil, Ph.D., ERDC; and, Charles H. Theiling, Rock Island District.

Absract: One of the difficulties of ecosystem scale environmental management is the large number of components to identify and consider for action. There is often no clear pattern of resource priorities or sequences of activities, besides "doing something with water" or "mo' betta." The multiple interested parties involved with an ecosystem project all may have their priorities and ideas but there may be as many of those as there are parties. A conceptual model is one available tool to help improve system understanding, facilitate communication, and plan actions.

Conceptual models can be constructed by a process of identifying the uses for the model and its spatial and temporal domain, then the major components of the ecosystem and their relationships. Depending on the intended use of the model, additional attention can be given to priority resources or problems, benefits evaluation, impact assessment, model selection, management actions, or monitoring feedback. Because model construction is usually an iterative process, attention can also be turned to a restructuring of the objectives, components, or relationships.

The initial format of the conceptual model we are describing is boxes, arrows, and words. The next generation of such a model can be in a spreadsheet or commercial model-building software. The most important part of the model, however, is the thought process that is reflected. This paper will describe the process of constructing and using a conceptual model using two hierarchal examples from the Upper Mississippi River.

Title: Use of Formal Decision Making Methods for USACE Projects
Presenter: Andrew C. Miller, Ph.D., ERDC

Abstract: Decisions associated with environmental concerns are too often needlessly complicated, confused, contentious, and, therefore, wrought with potential for poor and expensive outcomes. A formal process for decision-making, the Multiattribute Utility Analysis (MAUA), has recently been developed explicitly to overcome problems associated with multiple and conflicting objectives, uncertainty and bias among parties to a decision. MAUA has been used to guide business, legal, and engineering practices to avoid or minimize risks of poor decisions and maximize benefits of good decisions.

Recently we have used portions of the MAUA on three projects: 1) A concern over the likelihood of zebra mussels (*Dreissena polymorpha*) entering bayous in Southeastern Arkansas; 2) Methods for making choices among small restoration initiatives along the lower Mississippi and Apalachicola rivers; and 3) Techniques for implementing large-scale endangered species relocation projects. In all three of these projects the decision analysis framework allowed us to more thoroughly and appropriately examine all of the relevant decisions. We avoided the tendency to become bogged down in minor issues which did not lead to appropriate decisions. We feel that formal decision-making tools should be used whenever resource and development agencies collaborate on issues that involve more than a few thousand dollars, several stakeholders, and presence of an endangered, threatened, or ecologically valuable resource or its habitat. While good science does not necessarily result in good decisions, inappropriate decisions are more likely without decision-making methods.

SESSION III
TIME: Tuesday 13 April, 3:30-5:00
ROOM: Maryland - C
TRACK: Ecosystem Restoration
TOPIC: Formulation and Evaluation
MODERATOR: Phil Boawn, Albuquerque District

PRESENTATIONS:

Title: Formulation Issues in Ecosystem Continuing Authorities Program
Presenter: Gwen Albert, Southwestern Division

Abstract: I will discuss formulation issues that the SWD environmental staff frequently encounters in the review of Preliminary Restoration Plans (PRP), Planning and Design Analysis (PDA) and Detailed Project Reports (DPR). The formulation issues will be grouped into four areas: Selecting the appropriate authority; Describing existing condition; Future without Project conditions; and Evaluation of Alternatives. Evaluation of alternatives issues will be divided into 6 subgroups – scope, level of detail; formulating the Sponsor's plan; habitat evaluation; sustainability; and real estate.

I will also present some of the methods SWD uses to resolve these issues, such as eligibility determination letter reports, formulation checkpoint conferences, and checklists.

Title: Lessons Learned from Assessing Ecosystem Restoration Studies Across the Nation
Presenters: Antisa C. Webb, ERDC; and Kelly A. Burks-Copes, ERDC

Abstract: ERDC has participated and supported numerous Districts over the years in the assessment and design of ecosystem restoration and flood damage reduction studies across the country. Garnering information and experience in a trial and error fashion, scientists in ERDC's Environmental Laboratory have managed to accumulate an interesting list of problems and creative solutions to handle potentially study-killing issues that have arisen as they navigated through the convoluted USACE Planning Process. Given the positive feedback from Internal Technical Review Teams and Headquarters personnel, the success stories suggest that ERDC's strategies (i.e., Lessons Learned) could help other Districts better prepare for the complexities they face as they develop landscape-level projects in the coming years. Techniques for planning the studies on a watershed scale, as well as suggestions in selecting and modifying assessment tools will be presented. Case studies will be used to demonstrate both the positive and negative results of these approaches, and innovative solutions will be offered to assist Districts in avoiding these same pitfalls in future studies. Applications using assessment techniques such as Habitat Evaluation Procedures (HEP) and Hydrogeomorphic Wetland Assessments (HGM) will be highlighted, and suggestions for streamlining these tools will be presented as well. Creative approaches to addressing cost analyses requirements in planning studies will be provided, and a discussion of tradeoff approaches for handling multiple assessment techniques and results will be discussed.

Title: Lessons Learned in Applying Cost Effectiveness and Incremental Cost Analyses to the Indian River Lagoon - South Project
Presenter: Leigh Skaggs, Jacksonville District

Abstract: The Indian River Lagoon – South (IRL-S) Project Implementation Report (PIR), the first of the Comprehensive Everglades Restoration Plan projects submitted for authorization, was completed in

March 2004. The project's primary planning objective is the restoration of the IRL-S aquatic ecosystem, demonstrated through increased oyster and seagrass production and suitable habitat for oysters and seagrasses, through an improved salinity regime, reduction in average annual phosphorus and nitrogen loads, and remediation of muck build-up in the St. Lucie River and Estuary and the southern Indian River Lagoon. A secondary objective is an increase in the spatial extent and quality of wetlands in the IRL-S watershed.

Several challenges faced by the Project Delivery team (PDT) were related to developing ecosystem outputs and conducting cost effectiveness and incremental cost analyses (CE/ICA). The issue of translating hydrological and ecological performance measure achievement into quantified ecosystem outputs is addressed in Traxler et al. companion presentation, "Linking Performance Measures to the Development of Habitat Units: the Experience of the Indian River Lagoon- South Project." Once the PDT had developed habitat units to express the quality and quantity of habitat for six estuarine and watershed ecosystem resources (oyster habitat, submerged aquatic vegetation habitat, benthic habitat, wetlands requiring 100% restoration, wetlands requiring 50% restoration, and uplands habitat), another challenge was conducting CE/ICA on these multiple outputs. Different alternatives favored different output categories. To better interpret CE/ICA results, combined metrics were developed to demonstrate how effectively and efficiently alternatives produced all output categories. Normalization and weighting techniques were employed to combine unlike metrics. CE/ICA results were displayed in a variety of formats and the results were instrumental in the selection and justification of the recommended plan. A final challenge addressed was separating fully formulated "multi-purpose" alternatives into separate "single purpose" features (and estimating costs and ecosystem outputs for those features) to demonstrate the efficiency and synergistic superiority of the "multi-purpose" alternative over the combined "single-purpose" features.

Title: **Linking Performance Measures to the Development of Habitat Units: the Experience of the Indian River Lagoon - South Project**

Presenters: **Steve Traxler, USFWS; Patti Sime, South Florida Water Management District; and Leigh Skaggs, Jacksonville District.**

Abstract: The Indian River Lagoon – South (IRL-S) Project Implementation Report (PIR), the first of the Comprehensive Everglades Restoration Plan (CERP) projects submitted for authorization, was completed in March 2004. The project was formulated both to restore the aquatic ecosystem of the St. Lucie River and Estuary and southern Indian River lagoon (which have been severely degraded due to detrimental changes to the salinity regime, excessive nutrient loads, and accumulation of muck.) as well as to increase the spatial extent and quality of wetlands in the watershed. One of the many challenges faced by the Project Delivery team (PDT) was how to translate the extensive information related to how well the various alternative plans performed on a variety of hydrological and ecological performance measures (e.g., salinity levels, phosphorus load reduction, number of focal species) into quantified ecosystem outputs that could be used to conduct cost effectiveness and incremental cost analyses (CE/ICA). The PDT developed habitat quality indices that reflected percent of performance measure target level achievement (e.g., percent of phosphorus load reduction target to the Saint Lucie Estuary) to express the quality and quantity of habitat for six estuarine and watershed ecosystem resources (oyster habitat, submerged aquatic vegetation habitat, benthic habitat, wetlands requiring 100% restoration, wetlands requiring 50% restoration, and uplands habitat). In addition to estimating habitat units for future with-project and without-project conditions in 2050, the PDT considered ecosystem response over time to both external physical events (e.g., periodic high flow events from Lake Okeechobee discharges) as well various project features to calculate average annual habitat units. These average annual values were estimated assuming two sets of conditions: that the other CERP projects on which the IRL-S is dependent would eventually be constructed, and that other CERP projects would not be constructed. The alternatives had to be evaluated and justified under both conditions. The PDT developed various graphical displays to portray the increases and decreases of ecosystem outputs over the period of analysis.

SESSION V
TIME: Wednesday 14 April, 3:30-5:00
ROOM: Maryland - C
TRACK: Ecosystem Restoration
TOPIC: Innovative Analytical Procedures and Tools
MODERATOR: Terry Birkenstock, St. Paul District

PRESENTATIONS:

Title: Stream Restoration or Stormwater Management: Setting Priorities in Urban Watersheds
Presenter: Stacey Sloan-Blersch, Baltimore District

Abstract: Aging infrastructure, encroachment on riparian buffers, and under sized culverts are familiar problems an urban watershed manager must face on a daily basis. Add to the list the requirement to implement total maximum daily load standards, and stormwater management moves to the top of the list for most local sponsors. Traditional methods for controlling stormwater were based on "out of sight, out of mind" attitudes of water in urban areas. Streams were seen merely as conveyances for stormwater, and many were re-designed to function as drainage ditches. However, this convenience has come at a high price: the loss in biologic integrity, the destruction of in-stream habitat, and the decline in water quality. Is it possible then to address stormwater issues in urban areas and still create a healthy functioning stream? After numerous attempts by local sponsors to repair failing gabion walls and armored banks, a long-term solution seemed almost hopeless and in many cases, stream sections were simply piped. Recent developments in stream restoration techniques and stormwater management have renewed interest in attempting to restore the streams to some stable form and thereby, provide fish habitat. The Baltimore District is working with sponsors throughout the DC metropolitan area on stream restoration plans to protect and restore what little stream habitat remains in the Nation's Capital. This presentation will focus on efforts in two streams: Pope Branch and Watts Branch. Although both of these streams are in the coastal plains and considered unstable, both are re-adjusting differently. A discussion of channel forming flow in urban streams will be discussed, along with methods for working in existing degraded channels and daylighting piped sections of streams. Partnering at a watershed level will also be discussed with stormwater management as a necessary element to achieve the goal of restoring in-stream habitat.

Title: Clear Creek Watershed, Flood Damage and Ecosystem Restoration Study
Presenters: Andrea Catanzaro, Galveston District; Robert W. Heinly, Galveston District; Antisa C. Webb, ERDC; and Kelly A. Burkes-Copes, ERDC

Abstract: The Clear Creek watershed is approximately 47 miles long and extends from the Galveston Bay area inland to the southeast suburbs of Houston, Texas. The Galveston District is conducting a re-evaluation study for flood damage reduction while addressing ecosystem restoration opportunities on Clear Creek and six of its tributaries. Co-sponsors include Harris County Flood Control District, Galveston County, and Brazoria Drainage District No. 4. The previously authorized project focused on channelizing Clear Creek to address area flooding over the last thirty years. Due to environmental concerns, local sponsors and private citizens proposed alternatives to channelization including creating bypass channels and floodwater detention areas. In addition, non-structural options such as raising or buying out frequently flooded structures are also being considered. The District is partnering with the U.S. Army Engineer Research and Development Center, Environmental Laboratory (ERDC), state and federal environmental resource agencies, and the local sponsors, to ensure all stakeholder issues are addressed. With ERDC's support, the District is developing three community-based Habitat Suitability

Index models (Prairie, Tidal Marsh, Floodplain Forest) to evaluate changes to the aquatic and terrestrial system resulting from project implementation using the Habitat Evaluation Procedure (HEP). This presentation describes approaches and rationales for addressing multipurpose planning for flood damage reduction and ecosystem restoration, the benefits and challenges of inter-agency planning efforts, and the methods and models used to provide qualitative and quantitative information on project benefits. Increased biodiversity is expected through the re-establishment of wet prairie areas, salt marsh and forested wetlands, and meandering sections of the creek. Reduced sediment loading is anticipated, which in turn should increase water quality and improve flood protection. The project will serve as a case study for the community-based habitat assessment approach for a HEP application in an ecosystem context, demonstrating the effectiveness and power of these models in evaluating ecosystem restoration success.

Title: Successes in Adaptive Management and Monitoring Corps-wide
Presenter: Steven Pugh, Baltimore District

Abstract: Aquatic ecosystem restoration is one of the most dynamic and exciting mission areas of the Corps of Engineers today. As the science and technology of ecosystem restoration advances, some of the important techniques that have emerged include the use of monitoring and adaptive management. Recently, the Planning Associates Class of 2003 conducted a systematic evaluation of how monitoring and adaptive management is being used on certain Corps of Engineers restoration projects around the USA. One of the issues that emerged from the evaluation was the challenge of funding effective monitoring and adaptive management efforts. The evaluation also found, however, that there have been several success stories. Monitoring and/or adaptive management have been used on projects of varying sizes and types. Several examples of the use of monitoring to evaluate projects, develop lessons learned and decrease total project costs were identified. Adaptive management has been utilized both during construction and to make post construction modifications to improve project outputs. In a climate of limited resources, a number of creative ways to accomplish monitoring and adaptive management have been implemented. The use of partnerships, ongoing programs, and supervised volunteers has been very effective and has resulted in some unique additional project benefits.

SESSION VI
TIME: Thursday 15 April, 1:30-3:00
ROOM: Maryland - C
TRACK: Ecosystem Restoration
TOPIC: Innovative Analytical Procedures and Tools
MODERATOR: Tom Swor, Nashville District

PRESENTATIONS:

Title: Mahoning River, OH, Environmental Dredging Study
Presenter: Carmen Rozzi, P.E., Pittsburgh District

Abstract: The Mahoning River is located in the northeast potion of the State of Ohio. It is a relatively mature river and drains approximately 1,133 square miles. Historically it has been the "life-producing artery of the Mahoning Valley." Due to the abundance of other natural resources such as iron ore and coal in the following century the area saw the growth of the steel and iron industries. The mills grew into great industrial complexes that lined 30 miles of the Mahoning River's riverbanks. The industries that lined the riverbanks were dumping over 200 barrels of wasted crude oil a day into the river. This continued through the 20th century to the mid 1970's. The quality of the river was so degraded aquatic habitat no longer existed. The river was no longer viewed as an asset to the region but rather a liability, something to stay away from. This presentation will discuss how in coordination with the Ohio Environmental Protection Agency innovative environmental quality (EQ) metrics have been developed to determine EQ outputs. The development of these metrics will be discussed.

Title: Interim Results of Post-Construction Monitoring, Lower Savannah River Environmental Restoration Project
Presenter: William Bailey, Savannah District

Abstract: In 2002, the U.S. Army Corps of Engineers Savannah District and the City of Savannah cooperated on a $4million project to restore flows in a tidal creek that feeds 4,000 acres of bottomland hardwoods, many of which are in a National Wildlife Refuge. Restored flows would rehydrate bottomland hardwoods that had become drier as flows in the main river had become concentrated by navigation cutoffs in the main river. To determine if the expected results were being achieved a five-year monitoring plan was developed. This paper will present the results of our interim review of our post-construction monitoring. Indications are that the flow has increased in Bear Creek, the project is performing as expected, and it's on track to provide the projected ecosystem benefits. In addition to the ecosystem restoration benefits the City has been able to decrease the need to treat water they withdraw at an intake located downstream of the project. The post-construction monitoring is scheduled to continue for another 3 ½ years. At that time, we will have collected 5 years of data after implementation of the project. The District will fully examine the data and prepare a report documenting the performance and accomplishments of the project. At this point, the project is functioning well and producing the results that all parties had hoped.

Title: Economic Benefits from Ecosystem Restoration Projects: Illustration with Oysters
Presenters: David Schulte, Norfolk District; and Jim Henderson, ERDC

Abstract: Planning and evaluation of ecosystem restoration projects should include consideration of economic benefits so as to incorporate the fullest range of benefits. A Technical Note (Henderson and O'Neil 2003) on considering economic values for use in evaluation of oyster reef restorations was

prepared for the Ecosystem Management and Restoration Research Program and describes an approach could be used for benefit analyses for other restoration projects.

The initial step is identification of economic services resulting from restoration; for oyster reefs, these services are water quality, commercial harvest, recreation, habitat, and erosion protection. Valuation of services requires information on costs (construction, operation, substitutes), a benefits valuation method, and project specific data. Often scarce project data requires reliance on data from similar markets or geographic areas. The next step is quantification of the economic benefits resulting from restoration. For commercial harvest services, the Norfolk District compared harvest values from Chesapeake Bay reefs. This comparison used productivities, operations strategies ("put and take" stocking versus no maintenance), and project life expectations to evaluate economic return on construction costs. The analysis assessed how long it takes to recover the construction costs from the harvest values of oysters. Variations in annual harvests (bushels/acre) significantly affect cost recovery, so that costs for Maryland projects, with restocking, are recovered in 30 years, this compared to upwards of 75 years without restocking for Virginia. Recreation participation increases due to cleaner water and improved recreational fisheries, and recreation benefits are evaluated using contingent valuation and travel costs methods. The final step is to summarize economic benefits. This summary may include: monetized benefits, qualitative descriptions of service changes ("increases" or "improvements"), and reference or transfer of benefits of similar projects. The ability to include economic benefits with ecological benefits will strengthen evaluations, providing comprehensive consideration of project outcomes.

Title: **El Rio Antiguo - A Case Study of the Assessment of Ecosystem Restoration Success Using HGM**

Presenters: **Kathleen M. Bergmann, Los Angeles District; Kelly A. Burks-Copes, ERDC; and Antisa C. Webb, ERDC**

Abstract: Ecosystem restoration is often described as the recovery of limiting components, defined by their primary functional characteristics, be they water, soils, and/or habitat structure. The goal of restoration is focused on the restoration of such functional components within the study area. Traditionally, the focus of U. S. Army Corps of Engineer (USACE) projects has been flood control and other direct human benefits. When it comes to ecosystem restoration, people are likely to view the protection of endangered species and associated habitats as an important goal, however, the challenge remains to make ecosystem restoration the primary driving force in the overall study design. While ecosystem restoration produces a direct benefit for species, the benefit to humans is indirect. Such "non-use" benefits can result from the simple existence of healthy ecosystems and can be associated with incidental recreational benefits for humans. In 2002, the USACE Los Angeles District began the feasibility process of the El Rio Antiguo study. This effort included public outreach with the formation of a Citizen's Work Group. In addition, with areas of cultural significance found throughout the study site, the State Historic Preservation Office (SHPO) has, and would continue, to play an active role in the plan formulation process. The USACE Los Angeles District partnered with Pima County Flood Control District (PCFCD) and resource agencies (U.S. Fish and Wildlife Service [USFWS], Arizona Game and Fish Department [AGFD]) for plan formulation, community outreach, and to ensure all stakeholder issues were considered. In addition, the USACE Los Angeles District and PCFCD partnered with the USACE Engineer Research and Development Center Environmental Lab (ERDC-EL) for guidance with the evaluation of environmental restoration efforts using HGM or the Hydrogoemorphic approach to wetland assessments. For this study, the functional assessment was used as a tool to convey the collective expert knowledge of the study team regarding the restoration alternatives into a format (the HGM format) that evaluated the quality and quantity of the proposed restored ecosystems. In essence, the HGM assessment provided the basis for the "biological yardstick" to determine restoration selection criteria and screen alternatives in terms of effective and efficient restoration benefits. The results of the study will be presented in detail, including the plan formulation process, the evaluation and comparison the No Action alternative and the 20 alternative designs formulated, and the cost effectiveness/incremental cost analyses.